

A NON-NOBLE FRONT METALLIZATION PROCESS

SPECTROLAB, INC.

Alexander Garcia III

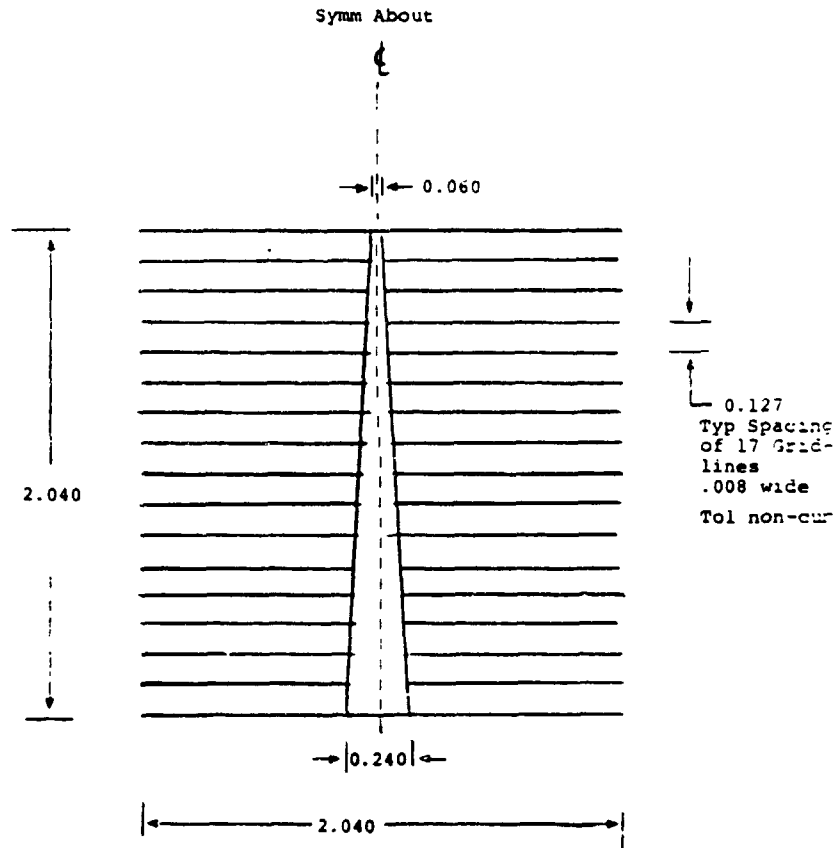
Objectives

- OPTIMIZATION, EVALUATION AND DEMONSTRATION OF A NOVEL METALLIZATION SYSTEM
- Mo/Sn/TiH SYSTEM
- ITO CONDUCTIVE AR SYSTEMS

Approach

- SCREEN PRINTING
- AIR FIRING
- REDUCING ATMOSPHERE
- CONDUCTIVE AR COATING (ITO)

Front Metallization Pattern



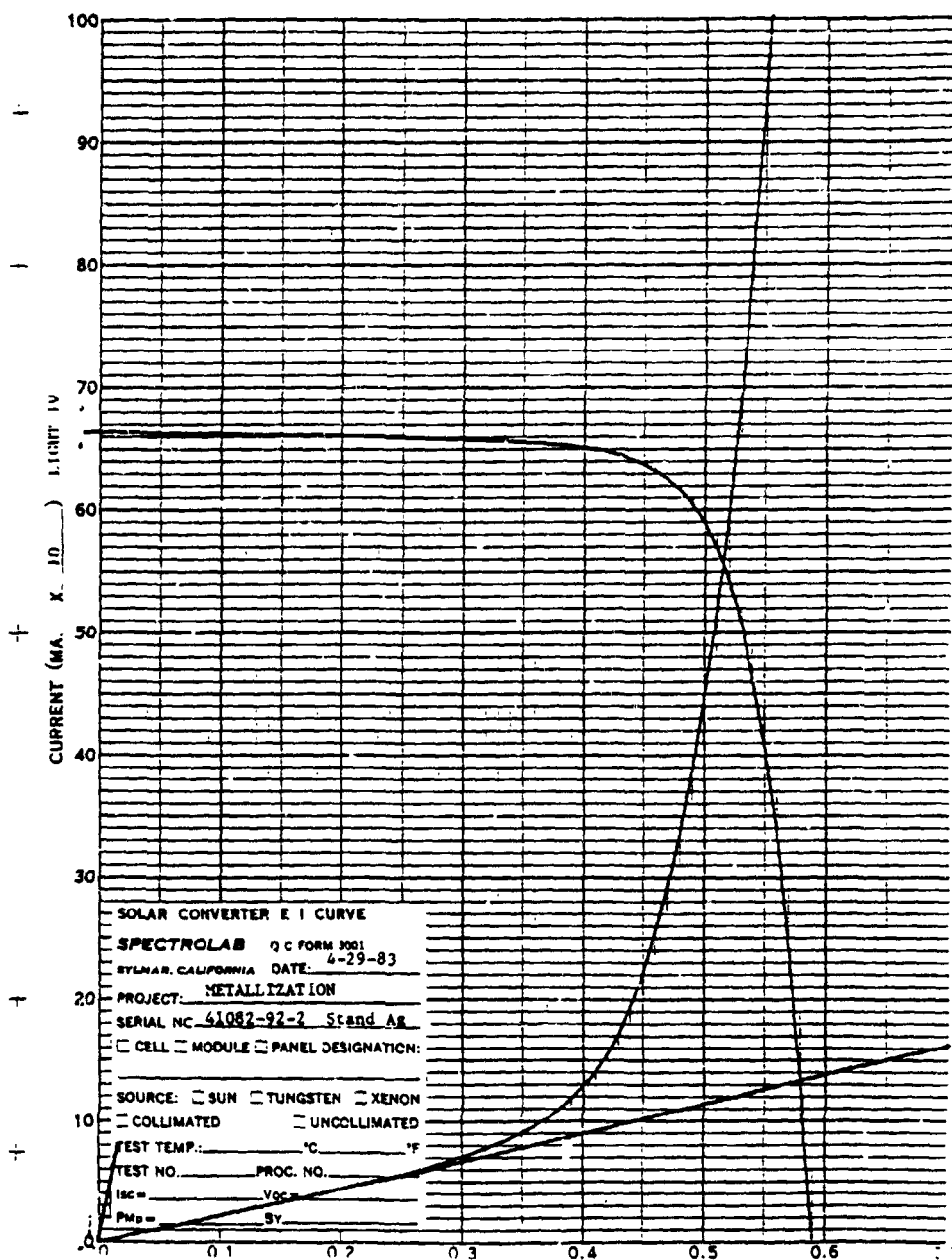
Mo-Sn vs Ag

CELL	V_{oc}	I_{sc}	I_{500}	P_{MAX}	FF	E
1728M-90 (Mo/Sn)	.601	.678	.596	.229	.73	10.5%
1728M-72 (Ag)	.601	.680	.600	.302	.74	10.6%

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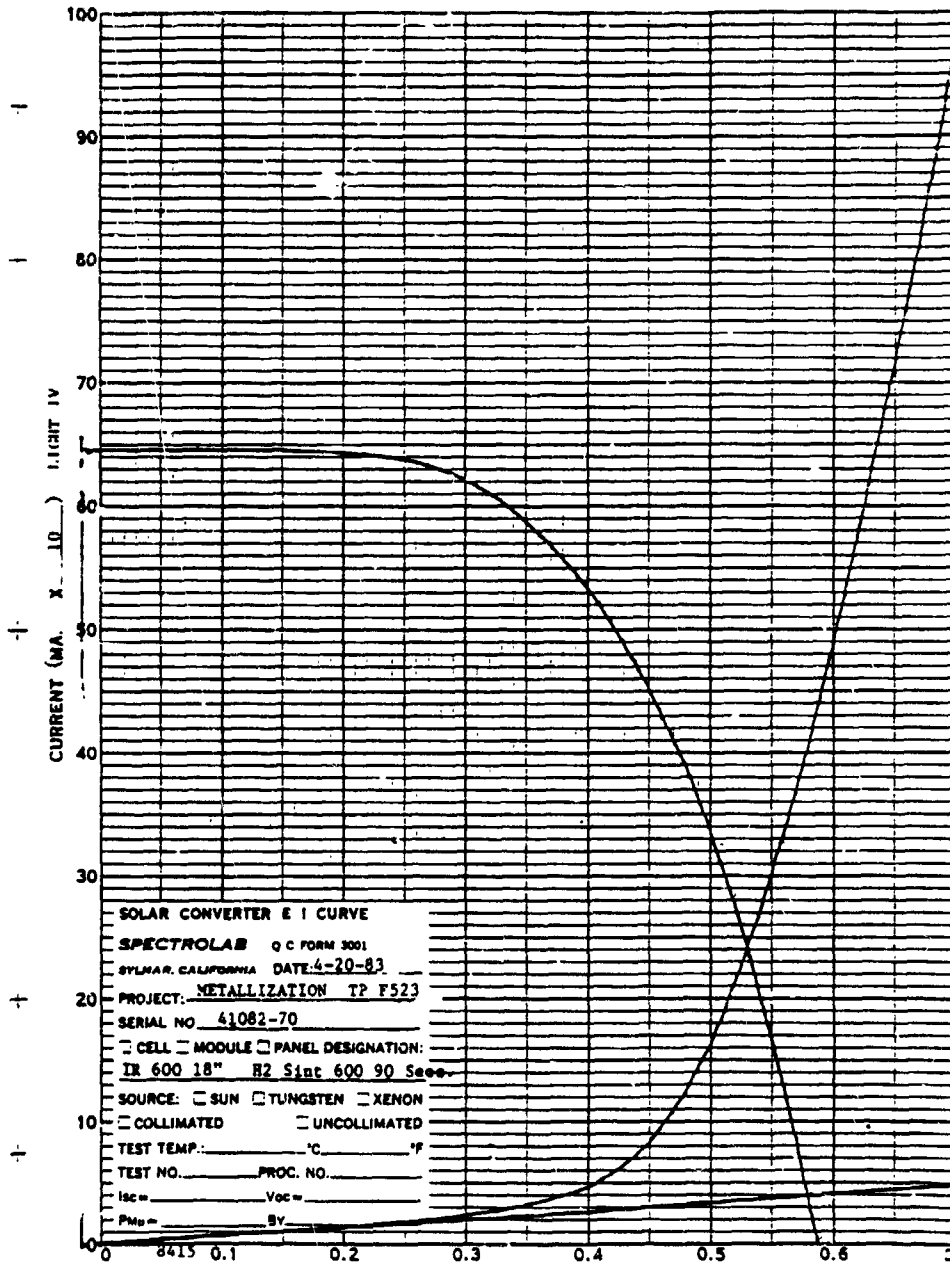
PROCESS DEVELOPMENT

Standard Ag Cell



PROCESS DEVELOPMENT

Typical Mo-Sn Cell



Problems With Hydrogen Reduction

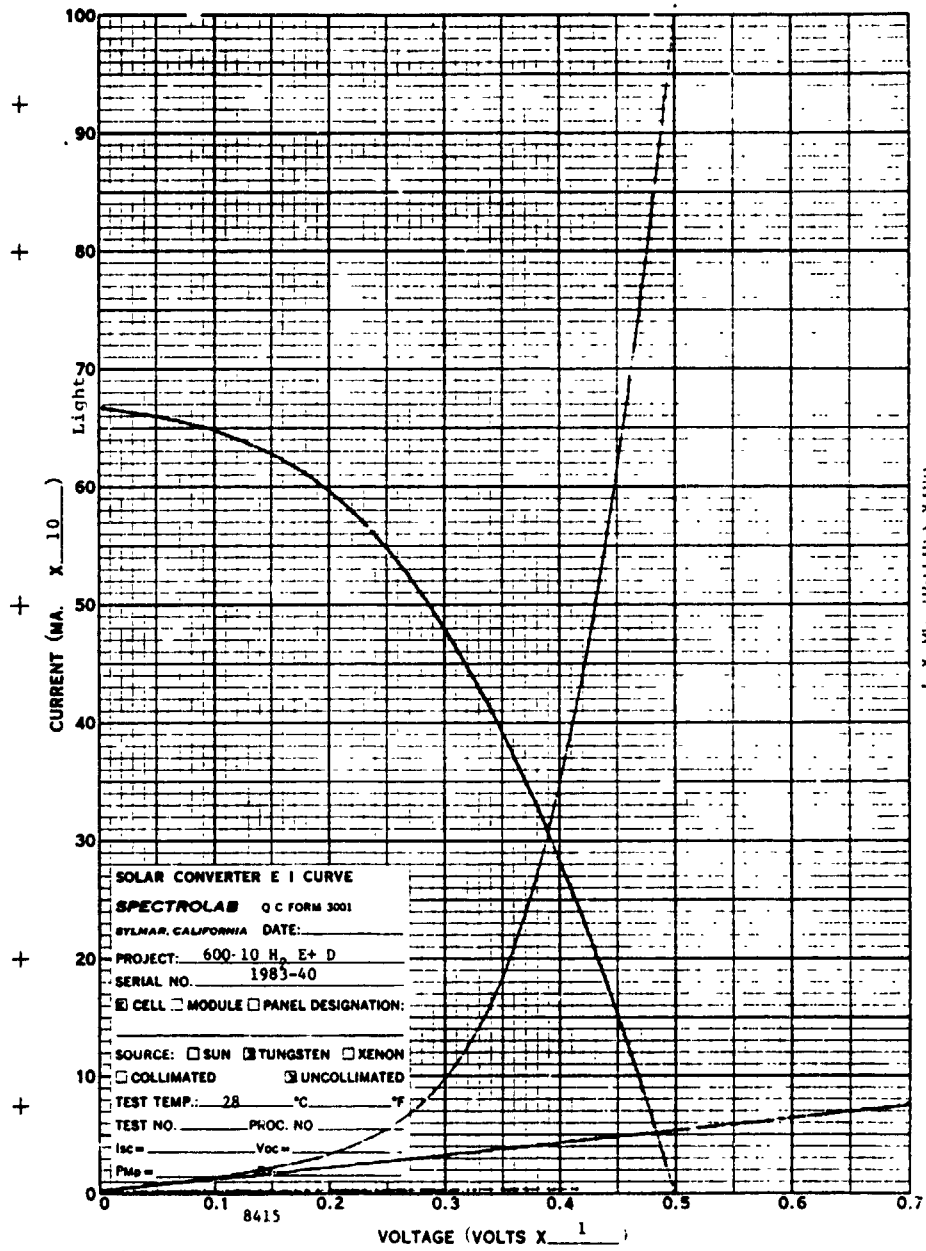
- POOR ADHESION
- FRIT DOES NOT APPRECIABLY WORK
- SI-POWDER BOND A PROBLEM
- SOLDERING A PROBLEM

Paste Additives Investigated

- INDIUM
- LEAD
- CADMIUM
- ANTIMONY
- ZINC

New Pastes Investigated

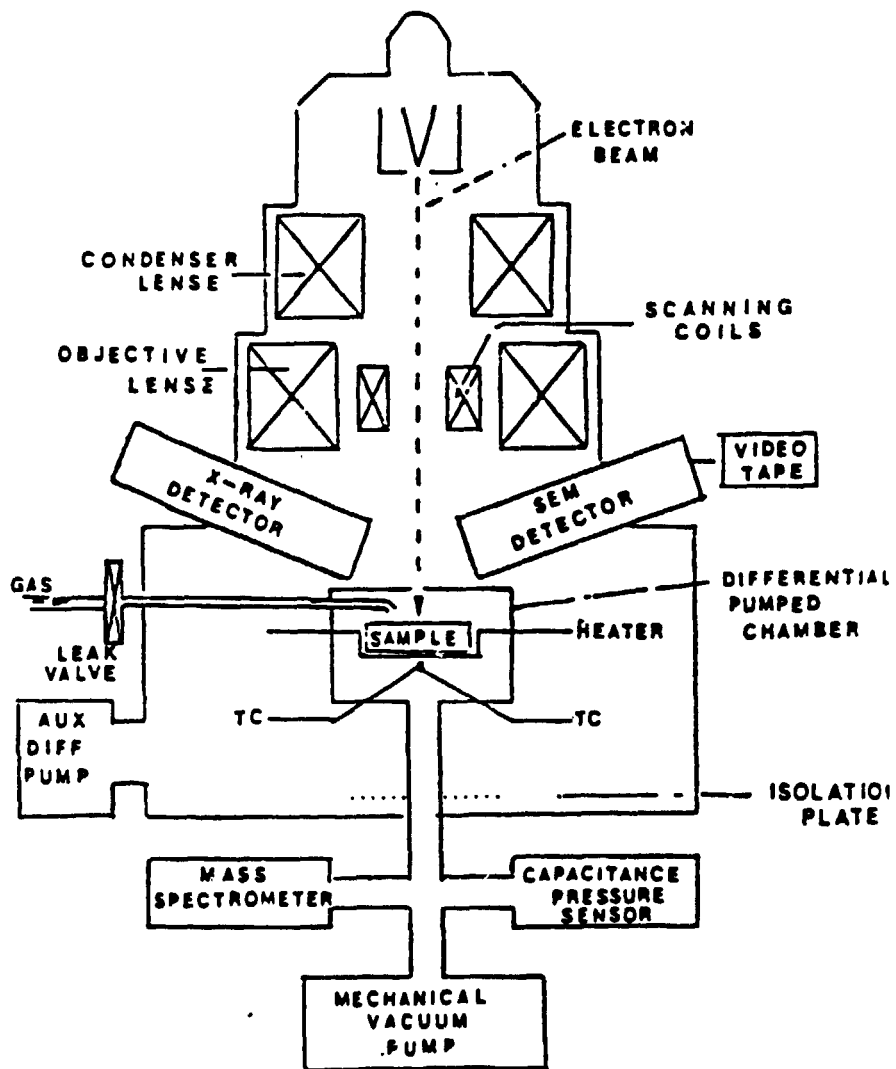
- MoO_3 PASTE
- BORANE-PYRIDINE
- Ag NEODECANATE
- Ag RESINATE
- IN RESINATE



New Analytical Technique

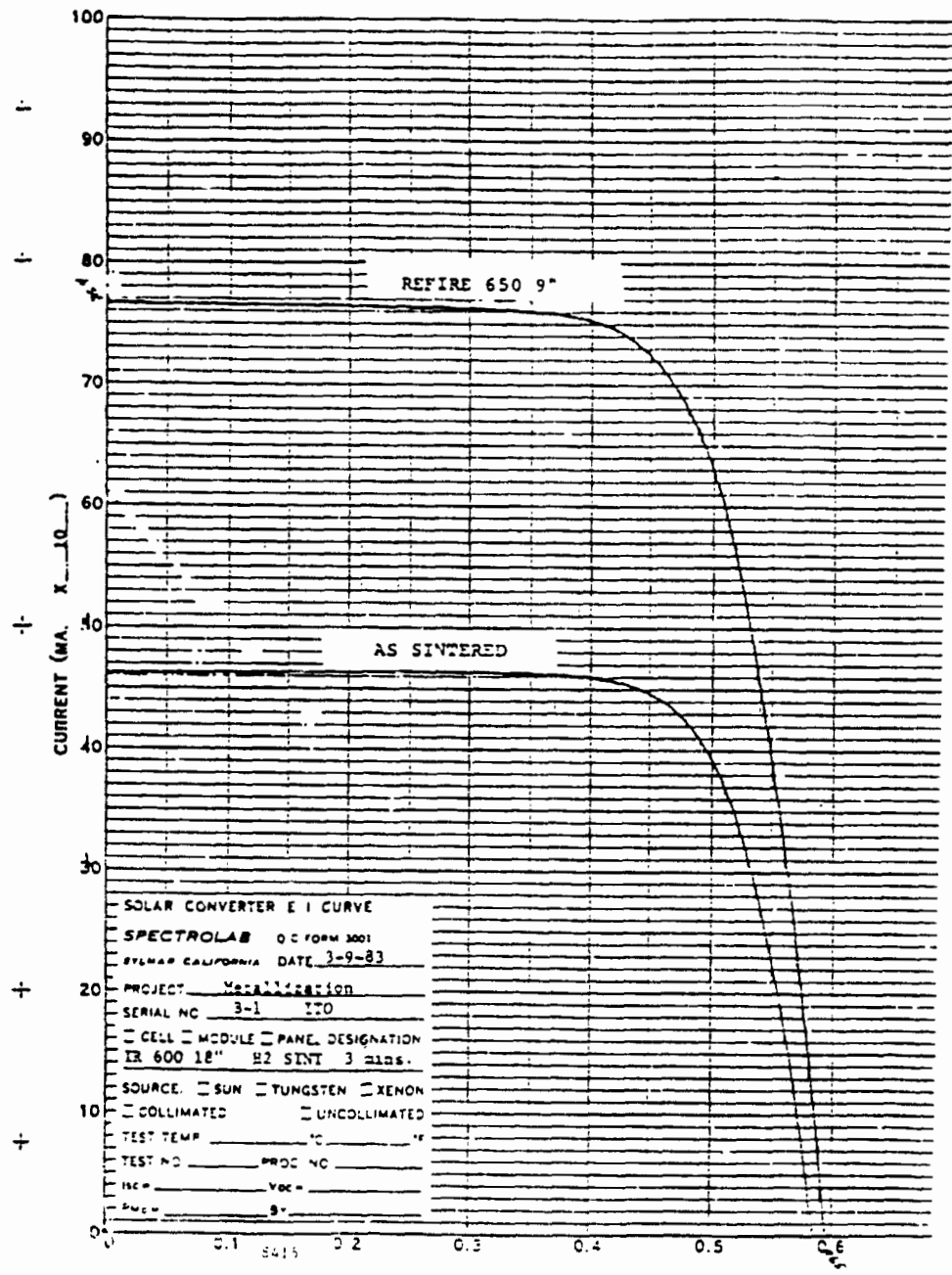
- CONTROLLED ATMOSPHERE SEM
- VIDEO TAPE PICTURE AS SAMPLE IS BEING HEATED
- VARIOUS GASES AVAILABLE @ 5 TORR

Controlled-Atmosphere SEM



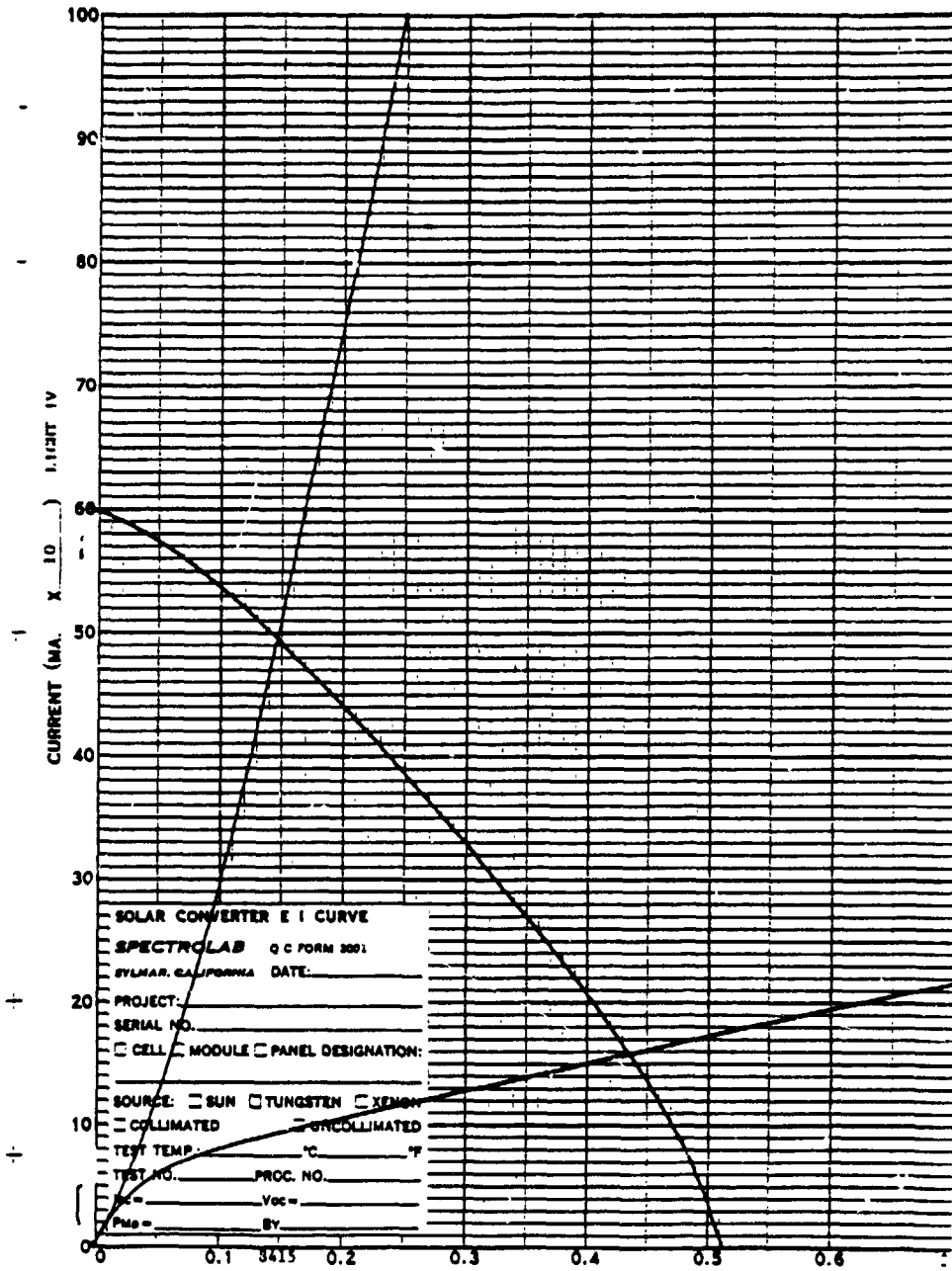
PROCESS DEVELOPMENT

ORIGINAL PANELS
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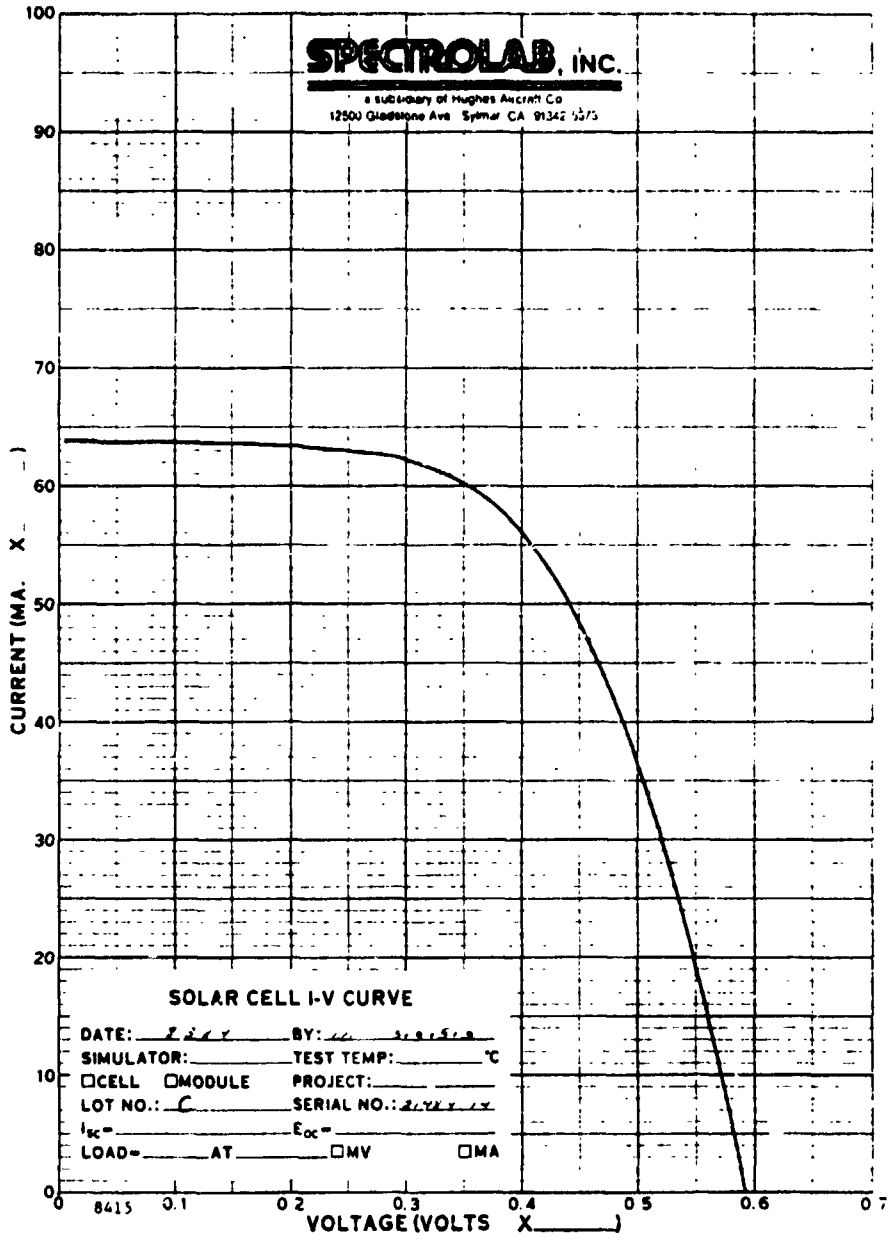


SOLAR CONVERTER E I CURVE
 SPECTROLAB O.C. FORM 3001
 STENAP CALIFORNIA DATE 3-9-83
 PROJECT: Metallization
 SERIAL NO 3-1 ITO
 CELL MODULE PANEL DESIGNATION
 IR 600 18" H2 SINT 3 mins.
 SOURCE: SUN TUNGSTEN XENON
 COLLIMATED UNCOLLIMATED
 TEST TEMP _____ °C _____ °F
 TEST NO _____ PROC NO _____
 ISC = _____ VOC = _____
 Pmax = _____

ITO Shunted Cell



PROCESS DEVELOPMENT



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Two-Step Process

- 1) PRINT Mo/Sn
- 2) PRE-FIRE
- 3) PRINT Ag PASTE
- 4) FIRE SILVER
- 5) FIRE Mo/Sn

- Mo/Sn MUST BE PRINTED FIRST

Results

- VARIOUS ADDITIVES UNSUCCESSFUL ON IMPROVING ADHESIVE
- SEM RESULTS SHOW TIN DOES NOT WET SYSTEM AT LOW TEMPERATURE
- TWO-STEP PROCESS MOST SUCCESSFUL

Conclusions

- Mo/Sn HAS ADEQUATE CONDUCTIVITY FOR SCREEN PRINTING
- SHUNTING IS NEVER A PROBLEM
- SOLDERABILITY A MAJOR PROBLEM
- MORE WORK NEEDED ON WETTING PHENOMENA
- CELLULOSIC VEHICLE BEST
- TWO-STEP PROCESS MOST SUCCESSFUL